EXHIBIT B

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TR 72570
Issue 1, December 1996

Bell Atlantic Technical Reference

Analog Unbundled Loop Service with Customer Specified Signaling Technical Specifications

Bell Atlantic Network Services, Inc.
Technical Reference

TR-72570
Issue 1, December 1996

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This Technical Reference is published by Bell Atlantic to provide a technical description of Analog Unbundled Loop Service with Customer Specified Signaling. To the extent feasible, the description references or duplicates existing published technical references utilized by the industry.

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Bell Atlantic
Analog Unbundled Loop Service with Customer Specified Signaling
Technical Specifications

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1. General

1.01 This technical reference provides the technical specifications associated with the Analog Unbundled Loop Service with Customer Specified Signaling that is offered by Bell Atlantic. The service may not be universally available.

1.02 Whenever this technical reference is reissued, the reason(s) for reissue will be provided in this paragraph.

1.03 Analog Unbundled Loop Services with Customer Specified Signaling (AULSCSS) enable Other Telephone Companies (OTC) collocated in a Bell Atlantic Central Office (CO) to connect to analog subscriber loops to provide switched access services to end-user locations. AULSCSS provides a 2-wire or 4-wire channel that is suitable for the transport of analog services that use various types of signaling.

1.04 The technical specifications in this document assume that the OTC is collocated in the same CO as the AULSCSS service. In the future, Bell Atlantic may offer transport services for AULSCSS. In that case, the technical specifications associated with the transport service should be consulted.

2. Service Description

A. General

2.01 The description, terms, conditions, rates, regulations, and Universal Service Order Codes (USOCs) for AULSCSS are contained in applicable tariffs or contracts.

2.02 AULSCSS provides the customer with a voice grade transmission channel between the Central Office Distributing Frame (CODF) termination of OTC equipment in a Bell Atlantic CO and the Rate Demarcation Point (RDP) at an end-user customer location.

2.03 AULSCSS channels are suitable for the transport of analog voice grade signals between 300 and 3000 Hz.

2.04 A 2-Wire AULSCSS channel will support either loop-start, ground-start, loop reverse-battery, or customer-provided inband signaling. A 4-wire AULSCSS channel will support either loop-start, ground-start, loop reverse-battery, customer-provided inband, or duplex signaling.

2.05 AULSCSS is provided subject to availability on a first-come first-served basis. Special construction charges apply when appropriate facilities are not available.

B. Physical Characteristics

2.06 AULSCSS channels can be effective 2-wire or 4-wire. When the OTC or RDP interface is 2-wire, one conductor is called tip and the other conductor is called ring. When the OTC or RDP interface is 4-wire the conductors of the OTC or End-User transmit pair are called tip and ring and the conductors of the OTC or End-User receive pair are called tip 1 and ring 1.

2.07 An effective 2-wire AULSCSS channel has 2-wire interfaces at both the OTC POT and the RDP. In addition, an effective 2-wire AULSCSS channel consists entirely of 2-wire facilities or a combination of 2-wire and 4-wire facilities. A typical 2-wire AULSCSS configuration is shown in Figure 2-1.

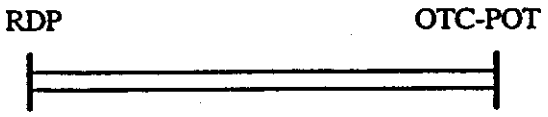

Figure 2-1: Typical 2-Wire AULSCSS configuration

2.08 A 4-wire AULSCSS channel has 4-wire interfaces at both the OTC POT and the RDP. In addition, the 4-wire AULSCSS channel consists entirely of 4-wire facilities with no 2-wire segments. A typical 4-wire AULSCSS configuration is shown in Figure 2-2.

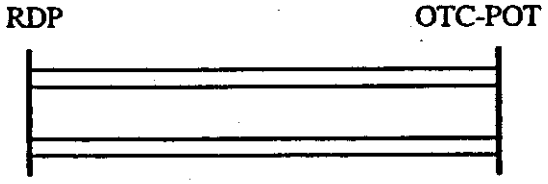

Figure 2-2: Typical 4-Wire AULSCSS configuration

2.09 AULSCSS channels may be provided using a variety of subscriber loop transmission technologies, including but not limited to, metallic cable, metallic cable based digital loop carrier, and fiber optic digital loop carrier systems.

C. Service Elements

2.10 AULSCSS ordinarily consists of two elements:

(1) the CODF wire and tie cable(s),

(2) a subscriber loop facility between the CODF and the end-user customer's RDP. The loop facility is either;

(a) a metallic facility consisting of cable and wire between the CODF and the RDP; or,

(b) a DLC facility channel with loop start (LS), ground start (GS), loop reverse battery (RV), or duplex (DX) signaling capability, or transmission-only (TO) capability for customer inband signaling applications, that consists of,

- CO cabling between the CODF and a DLC COT that is equipped with an LS, GS, RV, DX, or TO channel unit,

- a fiber or metallic facility from the DLC COT to the DLC RT that is equipped with an LS, GS, RV, DX, or TO channel unit, and,

- cable and wire between the DLC RT and the RDP.

D. Compatibility Considerations

2.11 Electronic transmission and signaling (T&S) enhancement equipment is not ordinarily used with AULSCSS. Examples of T&S are:

(a) a transmission repeater, or

(b) a transmission repeater with a signaling repeater, or

(c) a transmission repeater with signaling battery boost equipment.

2.12 If the OTC needs T&S equipment with AULSCSS to accommodate an OTC service, the OTC will be responsible for providing any such T&S equipment.

3. Service Element Design Criteria

A. General

3.01 Two elements are always used with AULSCSS. They are: CODF wire and tie cable(s), and subscriber loop facilities. The sections which follow contain the specifications for each of these elements.

B. CODF Wiring and Tie Cable(s)

3.02 CODF cross-connect wiring and tie cable(s) are used to link the CODF termination of OTC equipment to the CODF termination of metallic subscriber loops, DLC COTs, and electronic transmission and signaling enhancement equipment.

3.03 The total combined length of all CODF cross-connect wiring and all CODF-to-CODF tie cables between the CODF termination of the OTC equipment and the CODF termination of any subscriber loop in the same CO should be less than 1500 feet.

3.04 The direct-current resistance between the CODF termination of the OTC equipment and the CODF termination of any subscriber loop in the same CO should be less than 125 ohms. This is equal to 1500 or less feet of 26 gauge cable.

3.05 The 1kHz loss between the CODF termination of the OTC equipment and the CODF termination of a subscriber loop in the same CO, when measured between 900 ohm impedances, should be less than .85 dB.

3.06 The C-message noise measured on the wiring and tie cables between the CODF termination of the OTC equipment and the CODF termination of a subscriber loop in the same CO shall be 20 dBrnC or less.

C. Subscriber Loop Facilities

3.07 Subscriber loop facilities consist of feeder and distribution plant between the CODF and the end-user customer's RDP. Feeder plant uses a variety of transmission technologies, including but not limited to, twisted-pair metallic cables, twisted-pair metallic cable based digital loop carrier, and fiber optic based digital loop carrier. Distribution plant usually consists of multipair metallic cables. Additional information about subscriber loops may be found in Bellcore SR-TSV-002275 [1].

3.08 A twisted-pair metallic loop facility consists entirely of metallic cable and wire between the CODF and the end-user customer's RDP. Most metallic loops consist of multipair cables, laid out on aerial, underground, or buried routes to suit the needs of a particular community. The metallic loop facility may be loaded or non-loaded. It may also have bridged-tap. Loaded bridged-tap and bridged tap between load coils are not permitted.

3.10 A universal DLC facility consists of CO cabling between the CODF and a DLC COT, OSP fiber or metallic cable facilities from the DLC COT to the DLC RT, and cable and wire between the DLC RT and the end-user customer's RDP. Some universal DLC will not support enhanced services such as distinctive ringing, forward disconnect, caller ID, etc.

3.11 Subscriber loop facilities have been designed on a global basis primarily to accommodate POTS and guarantee that loop transmission loss is statistically distributed and that no single loop exceeds the signaling range of the CO.

3.12 Prior to 1980, loops were designed using one of the following design plans: Resistance Design (RD), Long Route Design (LRD), or Unigauge Design (UD). From 1980 to 1986, the Modified Resistance Design (MRD), Modified Long Route Design (MLRD), and Concentrated Range Extension with Gain (CREG) plans were applied on a going-forward basis (i.e., retroactive redesign

was not implemented). In 1986, the Revised Resistance Design (RRD) plan was applied on a going-forward basis. Appendix A provides a summary of the various loop design plans.

3.13 Most metallic loop facilities (98%) were designed using the RD, MRD, or RRD design rules. The RRD design rules currently in use limit the loop resistance to the design range of the CO switch or 1500 ohms whichever is less. CO switches have a range of either 1300 or 1500 ohms. The 1 kHz loss of RRD loops is 8.5 dB or less.

3.14 A small number of loops have been designed using the LRD, MLRD, UD, and CREG design plans. These loops are long (15+kft) and have high resistance (up to 2800 or 3600 ohms) and high loss (up to 13 dB without gain). Such loops require electronic transmission and signaling range enhancement equipment to accommodate AULSCSS. The LRD and MLRD design plans use Range Extension with Gain (REG) equipment that is either dedicated to each loop or hard-wired to the BA CO line equipment. In the latter case, the hard-wired REG is not available for use on AULSCSS.

3.15 The REG equipment used with CREG designed loops is implemented behind a stage of switching concentration in the associated CO switch. This permits REG equipment to be shared with other loops working out of the same CO switch. For this reason, the REG associated with CREG designed loops is not available for use on AULSCSS.

3.16 Bell Atlantic will work with the OTC to explore available options when an LRD, MLRD, or CREG designed loop requires enhancement to support AULSCSS.

3.17 The direct-current resistance of a metallic loop facility measured between the CODF and the RDP shall be 1520 ohms or less if the facility was designed using RD, MRD, or RRD rules. The resistance will be less than 2500 ohms if the facility was designed using UD rules, less than 2800 ohms if the facility was designed using CREG or MLRD rules, and less than 3600 ohms if the facility was designed using LRD rules.

3.18 The 1kHz loss of a metallic loop facility when measured with a 900 ohm impedance at the CODF and a 600 ohm impedance at the RDP shall be 8.0 dB or less if the loop was designed using RD, MRD, or RRD rules. The loss will be 10 dB or less if the loop was designed using LRD or MLRD rules, and 13 dB or less if the loop was designed using UD or CREG rules.

3.19 The C-message noise measured on a metallic subscriber loop at the RDP shall be less than 30 dBrnC.

3.20 The leakage resistance between the tip conductor and ground, the ring conductor and ground, and tip and ring conductors of a loop should each be greater than 100 K ohms.

3.21 The Power Influence (PI) measured per IEEE Std 743-1984 [2] on the metallic portion of a loop should be less than 90 dBrnC.

3.22 For LS and GS signaling, the DLC facilities provide a battery feed to the RDP. When the RDP is terminated by a direct-current resistance of 430 ohms or less, the loop current supplied by the DLC in such cases shall be 20 mA or greater.

3.23 The 1kHz loss of a DLC facility when measured with a 900 ohm impedance at the CODF and a 600 ohm impedance at the RDP shall be 8 dB or less.

3.24 The C-message noise measured on a DLC facility shall be 23 dBrnC or less.

3.25 The C-Notched noise measured on a DLC facility shall be 36 dBrnC or less with a -13 dBm0 1004 Hz holding tone.

3.26 The impulse noise measured on a DLC facility shall be no more than 15 counts in 15 minutes with a threshold of 59 dBrnC.

3.27 The echo return loss and singing return loss of a subscriber loop facility measured with a 900 ohm + 2.16 uf reference at the CODF and a 600 ohm + 2.16 uf termination at the RDP shall be equal to or greater than 5.5 dB and 2.5 dB respectively.

3.28 Subscriber loop facilities shall meet all applicable design specifications. (See appendix A)

4. Service Specifications

A. General

4.01 The overall end-to-end AULSCSS service is from the CODF appearance of the collocated OTC equipment to the end-user customer's RDP. AULSCSS service will use the TXNU service code.

B. Performance

4.02 Loss and C-Message noise will be measured during acceptance testing of new services at turn-up. Services that reuse existing working loops are only tested for continuity at turn-up.

4.03 Other parameters are tested in response to trouble reports or when additional testing is purchased.

4.04 The acceptance limits and immediate action limits in Table 4-1 apply to AULSCSS channels.

4.05 When a AULSCSS channel is provided using DLC, the transmission performance of the channel is evaluated by measuring performance parameters on the overall end-to-end service.

Table 4-1
Acceptance Limits (AL) and Immediate Action Limits (IAL)
for AULSCSS channels

PARAMETER	AL	IAL
Loss	< 8.5 dB	> 10.0 dB
Resistance	< 1520 ohms	> 1520 ohms
Three-Tone Slope*	-1.5 to +5.5 dB	-2.0 to +6.5 dB
C-Message Noise	< 30 dBrnC0	> 30 dBrnC0
C-Notched Noise	< 36 dBrnC0	> 36 dBrnC0
Leakage	> 100 kohms	< 100 kohms
Echo Return Loss	> 5.5 dB	< 5.5 dB
Singing Return Loss	> 2.5 dB	< 2.5 dB
Power Influence	< 90 dB	> 90 dB
LS/GS Loop Current (DLC)	> 20 mA	< 20 mA

* Minus (-) means less loss and plus (+) means more loss.

C. Available Signaling

4.06 The following 2-wire signaling capability is available where facilities and equipment permit:

- No signaling (includes inband signaling furnished by the OTC).
- Loop-start closed-end at end-user RDP and loop-start open-end at the OTC-POT.
- Loop-start open-end at end-user RDP and loop-start closed-end at the OTC-POT.
- Ground-start closed-end at end-user RDP and ground-start open-end at the OTC-POT.
- Ground-start open-end at end-user RDP and ground-start closed-end at the OTC-POT.
- Loop reverse-battery terminating at the end-user RDP and loop reverse-battery originating at the OTC-POT.
- Loop reverse-battery originating at the end-user RDP and loop reverse-battery terminating at the OTC-POT.

4.07 The following 4-wire signaling capability is available where facilities and equipment permit:

- No signaling (includes inband signaling furnished by the OTC).
- Loop-start closed-end at end-user RDP and loop-start open-end at the OTC-POT.
- Loop-start open-end at end-user RDP and loop-start closed-end at the OTC-POT.
- Ground-start closed-end at end-user RDP and ground-start open-end at the OTC-POT.
- Ground-start open-end at end-user RDP and ground-start closed-end at the OTC-POT.
- Loop reverse-battery terminating at the end-user RDP and loop reverse-battery originating at the OTC-POT. This signaling capability is not available on a 4-wire basis when the loop facility includes DLC.

- Loop reverse-battery originating at the end-user RDP and loop reverse-battery terminating at the OTC-POT. This signaling capability is not available on a 4-wire basis when the loop facility includes DLC.
- Duplex (DX) signaling at EU-POT and OTC-POT.

4.08 The signaling associated with 4-wire interfaces can be derived from the associated simplex leads. BA provides the standard simplex sense for all 4-wire interfaces, that is, the B-lead or Ring conductor can be derived from the OTC and EU receive pair and the A-lead or Tip conductor can be derived from the OTC and EU transmit pair.

4.09 AULSCSS Network Channel (NC) codes and Network Channel Interface (NCI) codes are shown in the following figures: Figure 4-2 shows NC codes; Figure 4-3 shows OTC-POT NCI codes; and Figure 4-4 shows compatible NCI code combinations. Additional information concerning NC/NCI codes may be found in Bellcore SR-STS-000307 [3].

Figure 4-2: AULSCSS NC Codes

NC Code	Character 3	Character 4
LX	-	-

Figure 4-3: AULSCSS OTC-POT NCI Codes

NCI Code	Description
02QC3.OOB	2-Wire Ground-start signaling - Open End
02QC3.OOC	2-Wire Ground-start signaling - Closed End
02QC3.OOD	2-Wire Loop-start signaling - Open End
02QC3.OOE	2-Wire Loop-start signaling - Closed End
02QC3.OOF	2-Wire Transmission Only - No Signaling
02QC3.RVO	2-Wire Reverse-Battery - OTC Originating
02QC3.RVT	2-Wire Reverse-Battery - OTC Terminating
04QC2.DXO	4-Wire Duplex Signaling
04QC2.OOB	4-Wire Ground-start signaling - Open End
04QC2.OOC	4-Wire Ground-start signaling - Closed End
04QC2.OOD	4-Wire Loop-start signaling - Open End
04QC2.OOE	4-Wire Loop-start signaling - Closed End
04QC2.OOF	4-Wire Transmission Only - No Signaling
04QC2.RVO	4-Wire Reverse-Battery - OTC Originating
04QC2.RVT	4-Wire Reverse-Battery - OTC Terminating

Figure 4-4: Compatible AULSCSS NCI Code Combinations

EU-POT	OTC-POT
02GO2	02QC3.OOC
02GS2	02QC3.OOB
02LO2	02QC3.OOE
02LS2	02QC3.OOD
02NO2	02QC3.OOF
02RV2.T	02QC3.RVO
02RV2.O	02QC3.RVT
04GO2	04QC2.OOC
04GS2	04QC2.OOB
04LO2	04QC2.OOE
04LS2	04QC2.OOD
04NO2	04QC2.OOF
04RV2.T*	04QC2.RVO
04RV2.O*	04QC2.RVT
04DX2	04QC2.DXO

* 04RV2.T and 04RV2.O are not available when DLC facilities are used.

D. Available Options

4.09 No options are available for AULSCSS channels.

E. Compatible TLP Ranges

4.10 Compatible TLP ranges are shown in Figures 4-5 and 4-6.

Figure 4-5: Compatible TLP Ranges at the EU-POT and OTC-POT for 2-Wire AULSCSS Channels

Specified Protocol Code	EU/OTC Transmit TLP	EU/OTC Receive TLP
GO, GS, LO, LS, NO, RV	0	0 to -8.5 #

In general, the receive TLP is a function of the cable loss.

Figure 4-6: Compatible TLP Ranges at the EU-POT and OTC-POT for 4-Wire AULSCSS Channels

Specified Protocol Code	EU/OTC Transmit TLP	EU/OTC Receive TLP
DX, GO, GS, LO, LS, NO, RV	0	0 to -8.5 #

In general, the receive TLP is a function of the cable loss.

5. OTC Equipment and CO Cabling Requirements

A. OTC Equipment Requirements

5.01 Several different types of OTC equipment can connect to AULSCSS. The equipment can be collocated in a BA CO or located at the end-user premises. Examples are: transport equipment; transmission repeaters; transmission repeaters with loop signaling repeaters; transmission repeaters with signaling battery boost equipment; and special service channel units.

5.02 Co-located OTC equipment used for interconnection with AULSCSS shall meet all applicable requirements including those in this document as well as applicable generic equipment requirements in Bellcore documents GR-63-CORE [4] and GR-1089-CORE [5].

5.03 Co-located OTC equipment shall be manufactured in accordance with FCC, NEC, UL, and USDL requirements and orders applicable to Federal, State, and local requirements including, but not limited to, statutes, rules, regulations, orders, or ordinances, or otherwise imposed by law. Where requirements are not specified in this document, contractual technical requirements or other applicable documents, the manufacturer's requirements consistent with industry standards shall be met.

5.04 The open circuit tip-to-ring dc voltage that OTC equipment applies to BA cabling shall be less than 80 Vdc.

5.05 OTC equipment shall not deliver more than 2.5 watts of power to any load via BA cable.

5.06 OTC equipment shall not deliver more than 150 mA of loop current to any load via BA cable.

5.07 The noise limits for AULSCSS are predicated on the OTC equipment having a longitudinal balance of > 60 dB.

5.08 The impedance of OTC equipment shall be a nominal 900 ohms when collocated in a BA CO and a nominal 600 ohms when used on the end-user premises at or near the RDP.

5.09 The applied power level of any signal transmitted on AULSCSS averaged over 3 seconds shall not exceed -13 dBm0.

5.10 AULSCSS loops may be exposed to electrical surges from lightening and commercial power system disturbances. Despite protective devices on the CODF, some of these disturbances are likely to reach OTC equipment. OTC equipment shall be designed to withstand certain surges without being damaged, and shall fail in a safe manner under infrequent high stress.

5.11 The prevalent voltage-limiting device available for CO use is the 3-mil carbon block. This device has an upper 3c limiting voltage of 1000 volts peak under surge conditions and 600 volts rms (800 peak) at 60 Hz. OTC equipment connected to AULSCSS subscriber loop facilities protected by carbon blocks may be subjected to voltages up to these levels. Unexposed COs may

not have primary protection, and OTC equipment not coordinating with carbon blocks may need protection in these locations.

5.12 If the AULSCSS subscriber loop facility is exposed to commercial ac power, the CO protector may also include 350 mA heat coils for limiting the current that is permitted to flow to CO equipment. In addition, a protective fuse cable located outside the CO incorporating 24 or 26 AWG conductors to coordinate with the protector, serves to limit current to safe levels in the event of prolonged operation of the protector during power fault conditions.

B. OTC CO Cabling Requirements

5.13 The voice grade CO cabling used to terminate collocated OTC equipment on the CODF shall use twisted-pair conductors.

5.14 The type, gauge, and length of the OTC CODF cabling shall be specified based on this specification and OTC equipment requirements. If the specifications in this document differ from the OTC equipment manufacturers specifications, then the more stringent of the two shall be used.

5.14 The direct-current resistance of the CO cabling between the OTC equipment and the CODF shall meet the CO cabling requirements in the Bellcore FR-TSY-000064 [6] (i.e., 23 ohms or less). This is equivalent to 275 feet or less of 26 gauge cable, 440 feet or less of 24 gauge cable, and 700 feet or less of 22 gauge cable.

5.15 All CO cabling between OTC equipment and the CODF shall be connected as specified by the BA CO Engineer.

5.16 The 1kHz loss of the CO cabling between the OTC equipment and the CODF, when measured between 900 ohm impedances, shall be less than .15 dB.

5.17 The C-message noise measured on the CO cabling between the OTC equipment and the CODF shall be 20 dBrnC or less.

6. References

A. Definitions

Acceptance Limit (AL)
The maximum value of, or deviation, that is allowed at service turnup or IC acceptance.

Analog Unbundled Loop Service with Customer Specified Signaling (AULSCSS)
A service that provides an analog facility between a BA CO and a customer location that is capable of supporting signaling specified, at the time the service is ordered, by the customer.

Central Office (CO)
A telephone company building which houses equipment and facilities used to provide switched access services.

Central Office Distributing Frame (CODF)
Framework located in a CO that holds wire cross-connects which are used to interconnect cable terminations for end-user customer loops, switching system ports, and inter-office facilities.

C-Message Noise
The frequency-weighted, short-term average noise within an idle channel. The frequency weighting, called C-message, is used to account for the variations in 500-type telephone set transducer efficiency and end-user annoyance to tones as a function of frequency.

C-Notched Noise
The C-message frequency-weighted noise on a channel with a holding tone that is removed at the measuring end through a notch (very narrow band) filter.

Channel
An electrical, or photonic communications path between two or more points of transmission.

Closed End
The end of a switched access service that receives ringing and dial tone and transmits address signals.

dBm
A unit used to express power level in decibels relative to one milliwatt.

dBm0
A unit used to express power level referred to, or measured at, a zero transmission level point (0TLP).

dBrn
A unit used to express noise power relative to one picowatt (-90 dBm).

dBrnC
A unit used to express noise power relative to one picowatt measured with C-message weighting.

dBrnC0
A unit used to express noise power in dBrnC referred to, or measured at, a zero transmission level point (0TLP).

Decibel (dB)
The logarithmic unit of signal power ratio most commonly used in telephony. It is used to express the relationship between two signal powers, usually between two acoustic, electric, or optical signals; it is equal to ten times the common logarithm of the ratio of the two signal powers.

Duplex Signaling
A type of dc signaling that employs symmetrical and balanced signaling equipment at each end of the loop. One simplex conductor of the 4-wire loop is used for signaling and the other simplex conductor is used for ground potential compensation.

Echo Return Loss (ERL)
A frequency-weighted measure of return loss over the middle of the voiceband (approximately 560 to 1965 Hz), where talker echo is most annoying. (See Table 9 of IEEE Std. 743-1984)

End User (EU)
The term "end user" denotes any customer of a telecommunications service that is not a carrier, except that a carrier shall be deemed to be an "end user" to the extent that such a carrier uses a telecommunications service for administrative purposes, without making such a service available to others, directly, or indirectly.

End-User Point Of Termination (EU-POT)
The rate demarcation point (RDP) on an end user's premises at which Bell Atlantic's responsibility for the provision of the services described in this document ends.

Facilities
Any cable, poles, conduit, microwave, or carrier equipment, central office distributing frames, central office switching equipment, computers (both hardware and software), business machines, etc., utilized to provide the services offered by a telephone company.

Immediate Action Limit (IAL)
The bound of acceptable performance and the threshold beyond which BA will accept a customer's trouble report and take immediate corrective action.

Impulse Noise
Any momentary occurrence of noise on a channel that significantly exceeds the normal noise peaks. Impulse noise is analyzed by counting the number of occurrences that exceed a threshold.

Leakage
The resistance between the conductors of an insulated metallic pair or the resistance between each conductor of an insulated metallic pair and ground.

Loop Reverse-Battery Signaling
A type of switched access line dc signaling that uses loop-open and loop-closure signals to indicate on-hook and off-hook signals in one direction and normal battery polarity and reverse battery polarity to indicate on-hook and off-hook signals in the other direction. The end of the service that generates loop open and loop closure signals is called the originating end and the other end which generates the normal battery polarity and reverse battery polarity signals is called the terminating end.

Loop-start (LS) Signaling
A type of switched access line signaling in which the network provides a battery source. To initiate a call, customer premises equipment will provide a loop closure that causes dc loop current to flow which the network will detect.

Open End
The end of a switched access service that transmits ringing and dial tone and receives address signaling.

Other Telephone Company (OTC)
An organization that provides telecommunications services to the public.

Plain Ordinary Telephone Service (POTS)
The basic single line switched access service offered by local exchange carriers to residential and business customers. POTS uses loop-start signaling.

Power Influence (PI)
The power of a longitudinal signal induced in a metallic OSP facility by an electromagnetic field emanating from a conductor or conductors of a power system. PI is also called longitudinal noise or noise-to-ground.

Protocol Code
In general, a component of the Network Channel Interface (NCI) code that identifies the basic electrical function of the interface. For AULSCSS, the protocol codes (i.e., DX, GO, GS, LO, LS, NO and RV) identify the type of signaling if any.

Rate Demarcation Point (RDP)
The point at which Bell Atlantic network access recurring charges and responsibility stop and beyond which customer responsibility begins. The RDP is the point of demarcation and/or interconnection between a Bell Atlantic subscriber loop facility and end-user premises cabling or terminal equipment. Bell Atlantic facilities at, or constituting, the rate demarcation point shall consist of wire or a jack conforming to Subpart F of Part 68 of FCC rules.

Return Loss (RL)
A measure of the similarity between the two impedances at a junction. The higher the return loss, the higher the similarity. It is the ratio (in decibels) of the power incident upon the junction to the power reflected from the junction. If the two impedances at the junction are Z1 and Z2, then:

$$\text{return loss} = 20 \log \frac{|Z1 + Z2|}{|Z1 - Z2|} \text{dB}$$

Signal-to-Noise Ratio (S/N Ratio)
The ratio of the signal power to the noise power at a given point in a given system (usually expressed in decibels).

Singing Return Loss (SRL)
The frequency-weighted measure of return loss at the edges of the voiceband (SRL Low, 260 to 500 Hz and SRL High, 2200 to 3400 Hz), where singing (instability) problems are most likely to occur.

Signaling Repeater
Loop enhancement equipment that detects and regenerates signaling states.

Three-Tone Slope
The loss at 404 Hz and 2804 Hz relative to the loss at 1004 Hz.

Transmission Level Point (TLP)
A point in a transmission system at which the ratio, usually expressed in decibels, of the power of a test signal at that point to the power of the test signal at a reference point, is specified.

Transmission Repeater
Loop enhancement equipment that amplifies and equalizes voice grade signals.

Unbundled Loop
A transmission channel between a end-user customer location and a LEC CO that is not a part of, or connected to, other LEC services.

Voice Grade (VG)
A term used to describe a channel, circuit, facility, or service that is suitable for the transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3000 Hz.

B. Acronyms

ANSI	American National Standards Institute
AULSCSS	Analog Unbundled Loop Service with Customer Specified Signaling
BA	Bell Atlantic
CO	Central Office
CODF	Central Office Distributing Frame
COT	Central Office Terminal
CREG	Concentrated Range Extension with Gain
DLC	Digital Loop Carrier
GS	Ground-Start
LRB	Loop Reverse-Battery
LRD	Long Route Design
LS	Loop-Start
MLRD	Modified Long Route Design
MRD	Modified Resistance Design
OTC	Other Telephone Company
PI	Power Influence

POTS	Plain Ordinary (analog) Telephone Service
RD	Resistance Design
RDP	Rate Demarcation Point
REG	Range Extender with Gain
RRD	Revised Resistance Design
RT	Remote Terminal
TO	Transmission Only
T&S	Transmission and Signaling
UD	Unigauge Design
VF	Voice Frequency
VG	Voice Grade

7. Bibliography

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NOTE: These documents are subject to change; references reflect the most current information available at the time of printing. Readers are advised to check the status and availability of all documents.

Appendix A: Historical Loop Design Rules

1- Resistance Design (RD): (96% of loops designed prior to 1980)
- 0 - 1300 ohms
- Max BT on NL cable = 6 kft
- POTS = No loading to 18 kft, H88 loading beyond 18 kft
- CENTREX = No loading to 11 kft, H88 loading beyond 11 kft
- Max end section plus BT = 15 kft
- No loaded BT, No BT between load coils.

2- Long Route Design (LRD): (3% of loops designed prior to 1980)
- 1301 - 3600 ohms
- Applicable > 18 kft, full H88 loading
- Gain required for loops over 1600 ohms
- Max end section plus BT = 12 kft
- No loaded BT, No BT between load coils.

3- Unigauge Design (UD): (1% of loops designed prior to 1980)
- 0 - 2500 ohms
- No loading to 24 kft, partial H88 loading beyond 24 kft
- Gain applied to loops > 15 kft
- Max BT on NL cable = 6 kft
- End section plus BT = 12 kft
- No loaded BT, No BT between load coils.

4- Modified Resistance Design (MRD): (1980 - 1986)
- 0 - 1500 ohms
- Max BT on NL cable = 6 kft
- Total NL cable plus BT = 15 kft
- POTS = No loading to 15 kft, H88 loading beyond 15 kft
- CENTREX = No loading to 11 kft, H88 loading beyond 11 kft
- Loaded cable end section plus BT = 3 to 12 kft
- No loaded BT, No BT between load coils.

5- Modified Long Route Design (MLRD): (1980 - 1986)
- *1501 - 2000 ohms = Res Zone 18*
- 2001 - 2800 ohms = Res Zone 28
- RZ 18 = Range Extension plus 3 dB of gain
- RZ 28 = Range Extension plus 6 dB of gain
- Full H88 loading
- End section plus BT = 3 to 12 kft
- No loaded BT, No BT between load coils.

6- Concentrated Range Extension with Gain (CREG): (1980 - 1986, 1A & 2A ESS Only)
- 0 - 2800 ohms
- No loading to 15 kft, full H88 loading beyond 15 kft
- Range extension with gain (REG) required for all loops over 1500 ohms
- REG provided behind a stage of switching concentration
- Total NL cable plus BT = 15 kft max
- Max NL cable BT = 6 kft
- Loaded end section plus BT = 3 to 12 kft
- No loaded BT, No BT between load coils.

7- Revised Resistance Design: (after 1986)
- 0 - 18 kft = 1300 ohms max
- 18 - 24 kft = 1500 ohms max (CO permitting)
- No loading to 18 kft, full H88 loading between 18 - 24 kft
- Max NL cable plus BT = 18 kft
- Max BT on NL cable = 6 kft
- Loaded cable end section plus BT = 3 to 12 kft
- No loaded BT, No BT between load coils.